Vis/NIR Vicarious Calibration

Mark Hofstadter, JPL

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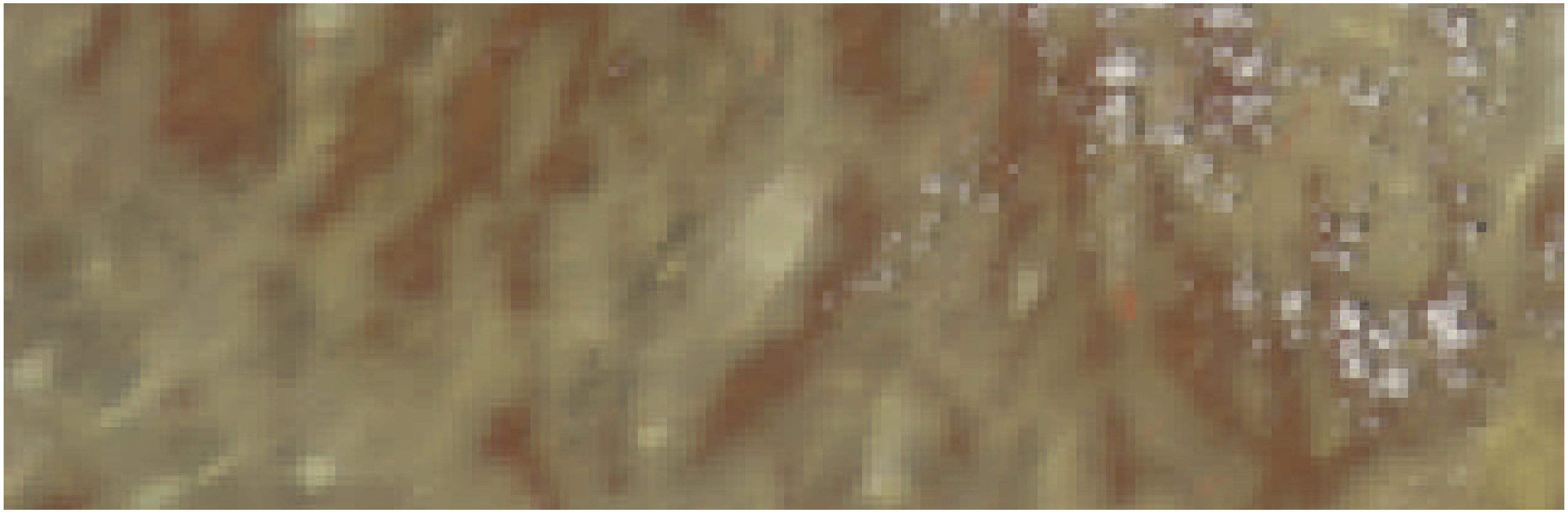
Summary

Use ground-based surface and atmospheric measurements to predict TOA radiances.

Adjust gains of Vis/NIR data to match model results to within the error bars.

Activity was coordinated with a MISR field campaign in Railroad Valley Playa, Nevada.

Resulting gains are good to ~10%. Complete report in ADFM-590.



Field Data and Model Results

After ~1 month in the field, two overpasses had clear skies with all equipment (ground and spacecraft) working: 10 and 11 June 2002.

Calculate TOA radiances using MISR, MODIS, and SBMOD forward models. Inputs from field data include incident solar energy (direct measure), surface BRDF (direct measure), and atmospheric aerosol and water vapor loading (retrieved from upward looking measurements). Solar and spacecraft viewing geometry from EOS toolkit (L1B files).

Table I: Summary of Observing Geometry and Model Radiances

Date in June	Time (UTC)	Solar Zenith (deg)	Solar Azimuth* (deg)	S/C Zenith (deg)	S/C Azimuth* (deg)	TOA Radiance ($W\,m^{-2}\,ster^{-1}\,micron^{-1}$) Ch. 1	Ch. 2	Ch. 3	Ch. 4
10	20:19	17.68	212.33	45.57	75.3	129.2613	155.7759	116.6813	129.2011
11	20:56	23.06	234.08	21.58	260.87	144.6209	181.9092	133.8255	149.1061

*Azimuth measured Eastward (CW) from due North

Spacecraft Data and Initial Gains

From Vis/NIR L1A files (Granules 203 and 210 of June 10 and 11, respectively), determine instrument counts (after subtracting offset) for Vis/NIR pixel centered closest to the field site.

Table II: Observed Instrument Counts

Date	Lat (ÞN)	Lon (ÞW)	Line	Sample	Instrument Counts (offset term removed)*			
					Ch 1	Ch 2	Ch 3	Ch 4
June 10	38.498436	115.68146	1052	65	235.635	701.143	676.187	674.913
June 11	38.496758	115.69576	717	499	280.722	840.235	797.143	799.353

*Instrument counts (offset subtracted) are from L1b product files, PGE version v2.3.3.2

Dividing model radiances by observed counts determines gain on each day, but only for one detector! Discrepancies between the days are consistent with the 5% error bars estimated by the MISR team on their calculated radiances. Due to exceptionally clear skies and better surface reflectance data, June 10th is considered superior (in spite of the larger spacecraft zenith angle, 46° vs. 22°).

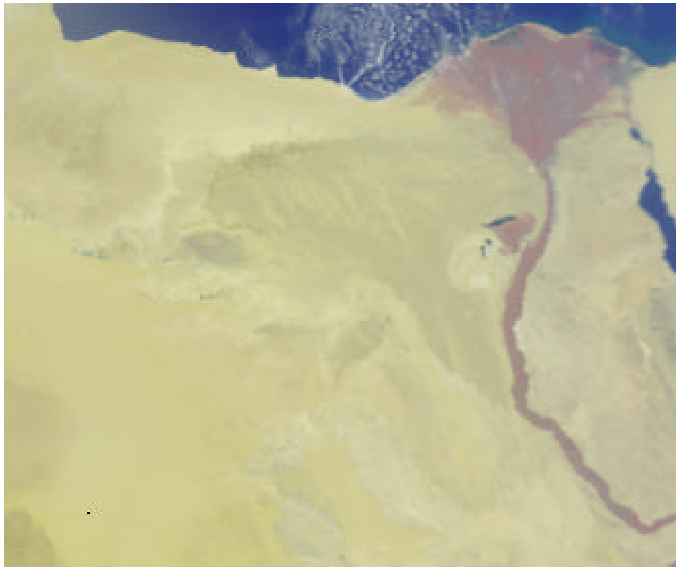
Table III: Single-Detector Gain Estimates

Date	Detector (one-based)	Gain (W m^{-2} $ster^{-1}$ $micron^{-1}$ per count)			
		Channel 1	Channel 2	Channel 3	Channel 4
June 10	8	0.5486	0.2222	0.1726	0.1914
June 11	6	0.5152	0.2165	0.1679	0.1865

Relative Gains Within Each Channel

Pick large, homogeneous regions. Expect the average counts observed by each of the nine detectors to be the same. Interpret variations as due to detector-to-detector gain differences. Use regions in both hemispheres, and on both sides of a swath, to avoid systematic geometric effects.

Sahara Desert, Granule 115, 14 June 2002.



Kalahari Desert, Granule 124, 20 July 2002

Relative Gains Within Each Channel (cont)

Variation among detectors appears to be at the 1% level within each channel. They are also remarkably consistent between test sites, suggesting geometric effects are small, at least for desert surfaces.

Table IV: Relative Gains

Detector	Gain Relative to (one-based) Detector 8							
	Channel 1		Channel 2		Channel 3		Channel 4	
	Sahara	Kalahari	Sahara	Kalahari	Sahara	Kalahari	Sahara	Kalahari
1	1.003	1.016	1.014	1.014	1.002	1.003	0.993	0.994
2	1.004	1.013	1.012	1.012	1.001	1.003	0.993	0.993
3	1.005	1.012	1.011	1.010	1.005	1.005	0.994	0.993
4	1.005	1.011	1.010	1.012	1.006	1.009	0.994	0.996
5	1.005	1.009	1.008	1.009	1.004	1.006	0.996	0.997
6	1.005	1.009	1.005	1.007	1.002	1.003	0.998	0.999
7	1.002	1.004	1.002	1.003	1.001	1.001	1.000	1.001
8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
9	0.997	0.996	0.997	0.998	0.994	0.996	0.998	0.999

Final Gain Determination and Caveats

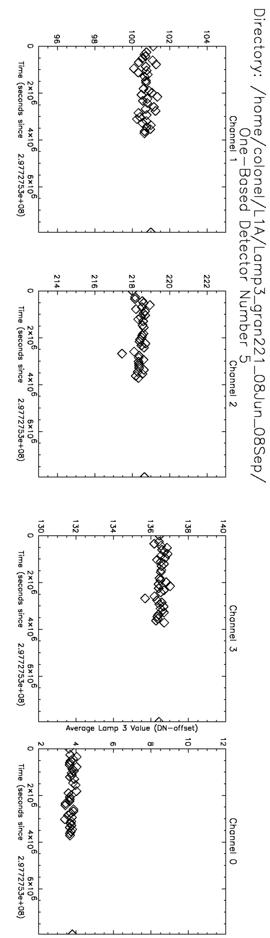
Applying the single-detector gains of Table III and the relative gains of Table IV we get the final values of Table V. Accounting for errors in the forward model, uncertainty in the spectral response function of our detectors, and the variations among test days and test sites, these values are uncertain by about 10%, but relative errors within a channel are much smaller, typically less than 1%.

Table V: Final Gain Determination

Detector	Gain (W m^{-2} $ster^{-1}$ $micron^{-1}$ per count)			
	Channel 1	Channel 2	Channel 3	Channel 4
1	0.5504	0.2252	0.1730	0.1900
2	0.5507	0.2248	0.1728	0.1900
3	0.5513	0.2246	0.1735	0.1902
4	0.5512	0.2244	0.1737	0.1902
5	0.5513	0.2240	0.1733	0.1906
6	0.5516	0.2234	0.1729	0.1910
7	0.5499	0.2227	0.1728	0.1914
8	0.5486	0.2222	0.1726	0.1914
9	0.5470	0.2215	0.1716	0.1911

Final Gain Determination and Caveats (cont)

The vicarious gains are calculated for June 10th, 2002. Observations of the on-board lamps, however, show us that the system has remained stable from launch to the present time.



Final Gain Determination and Caveats (cont)

Additional work is needed to refine gains beyond the 10% level. In particular, we are investigating the possibility of non-linearities in the system's response.